

LBYCV3B – Construction Materials and Testing Laboratory

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Experiment No. 2 and 3 Sieve Analysis of Aggregates

I. Introduction

Sieve analysis is the distribution of the particle size of an aggregate. Furthermore, fineness modulus is used for the verification of how uniform the grading is. The experiment applied sieve analysis and computed the fineness modulus of the sand and gravel aggregates. Moreover, it adopted the standard method in ASTM C136-83 for the procedure of this experiment.

With that, the experiment aims the following objectives:

- To analyze the grain size of the sand and gravel aggregates using sieve analysis;
- To compare and differentiate the grain size of gravel and sand aggregate;
- To determine the fineness modulus of the sand and gravel aggregates; and
- To figure out the significance of sieve analysis and fineness modulus, particularly in the engineering field.

II. Procedure

The following steps are conducted in the experiment:

- Apply the quartering method to scale down the field sample, using it as the test sample size.
- Using the temperature of $110 \pm 5^{\circ}\text{C}$, the sample is dried at a constant weight.
- The test sample will then be weighed through using the following criteria:
 - Fine aggregates:

Criteria	Minimum Weight of Test Sample
95% of the test sample will pass the 2.36 mm (No.8) sieve	100 g
85% of the test sample will pass a 4.75 mm (No.4) sieve and more than 5% will be retained on a 2.36 mm (No.8) sieve	500 g

- Coarse aggregates:

Nominal Maximum Size, mm	Minimum Weight of Test Sample
9.5	1 kg
12.5	2 kg
19.0	5 kg
25.0	10 kg
37.5	15 kg
50.0	20 kg

- The sieve is then organized in depreciating sizes of opening manner starting with the top to the bottom.
 - Sieve for Fine Aggregates: 10, 5, 2.5, 1.2, 0.6, 0.3, 0.15, pan
 - Sieves for Coarse Aggregates: 40, 25, 20, 12.5, 10, 5, 2.5, pan
- On the top sieve, the sample is set in it.
- Through the mechanized sieving machine, the sieves are shaken until a specific amount of time.
- Thoroughly check if only less than 1% have passed through the sieve.
- Weigh the retained sample of every sieve.
- Calculate the needed variables.

III. Data

Table 1.1: Sieve Analysis Data Sheet of Sand Aggregate

Sieve No. (Sieve	Retained in Each Sieve	Cumulative Retained	Percent
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Opening)	Weight (g)	Percentage (%)	Weight (g)	Percentage (%)	Passing (%)
10 mm	1.8	0.306	1.8	0.306	99.694
5 mm	12.6	2.141	14.4	2.447	97.553
2.5 mm	29.8	5.064	44.2	7.511	92.489
1.2 mm	80.2	13.628	124.4	21.138	78.862
0.6 mm	123.8	21.037	248.2	42.175	57.825
0.3 mm	176.1	29.924	424.3	72.099	27.901
0.15 mm	109.8	18.658	534.1	90.756	9.244
*Pan	54.4	9.244	588.5	100	0
Total	588.5			236.432	

Table 1.2: Weight Data Sheet of Sand Aggregate

Original Weight (g)	810.4	Sand and Pan
	221.2	Pan
	589.2	Sand
	0.12	% error

Table 2.1: Sieve Analysis Data Sheet of Gravel Aggregate

Sieve No. (Sieve Opening)	Retained in Each Sieve		Cumulative Retained		Percent
	Weight (g)	Percentage (%)	Weight (g)	Percentage (%)	Passing (%)
37.5 mm	0	0.000	0	0.000	100.000
* 25.0 mm	599.6	10.162	599.6	10.162	89.838
19.0 mm	952.3	16.139	1551.9	26.301	73.699
* 12.5 mm	2037.5	34.531	3589.4	60.832	39.168
9.5 mm	1602.5	27.159	5191.9	87.991	12.009
4.75 mm	692.6	11.738	5884.5	99.729	0.271
2.36 mm	4.2	0.071	5888.7	99.800	0.200
* Pan	11.8	0.200	5900.5	100	0
Total	5900.5			384.815	

Table 2.2: Weight Data Sheet of Gravel Aggregate

Original Weight (g)	6303.1	Gravel and Pan
	392.6	Pan
	5910.5	Gravel
	0.17	% error

Table 3: Fineness Modulus Data Sheet of Sand and Gravel Aggregate

Aggregate	Fineness Modulus
Sand	2.364
Gravel	7.138

Calculations:

Sand:

Percent retained in each sieve, ($\%r$):

$$\%r = 100 \times \frac{\text{Weight in Each Sieve}}{\Sigma \text{Weight in Each Sieve}}$$

$$\%r = 100 \times \frac{1.8}{588.5}$$

$$\%r = 0.306 \%$$

Cumulative weight retained, (W_c):

$$W_c = \text{Current Weight} + \text{Past Weight}$$

$$W_c = 1.8 + 0$$

$$W_c = 1.8 \text{ g}$$

Cumulative percent retained, ($\%c$):

$$\%c = 100 \times \frac{\text{Cumulative Weight in Each Sieve}}{\Sigma \text{Weight in Each Sieve}}$$

$$\%c = 100 \times \frac{1.8}{588.5}$$

$$\%c = 0.306 \%$$

Percent passing, (%p):

$$\%p = 100\% - \%r$$

$$\%p = 100\% - 0.306\%$$

$$\%p = 99.694 \%$$

$$\%p = \%p_1 - \%r$$

$$\%p = 99.694\% - 2.141\%$$

$$\%p = 97.553 \%$$

Percent error, (%e):

$$\%e = 100 \times \frac{\text{Original Weight of Sand} - \text{Total Weight Retained}}{\text{Original Weight of Sand}}$$

$$\%e = 100 \times \frac{589.2 - 588.5}{589.2}$$

$$\%e = 0.12 \%$$

Fineness Modulus, (FM):

$$FM = \frac{\Sigma \text{Cumulative Percent Retained}}{100}$$

$$FM = \frac{236.432}{100}$$

$$FM = \frac{2.365}{100}$$

Gravel:

Percent retained in each sieve, (%r):

$$\%r = 100 \times \frac{\text{Weight in Each Sieve}}{\Sigma \text{Weight in Each Sieve}}$$

$$\%r = 100 \times \frac{599.6}{5900.5}$$

$$\%r = 10.162 \%$$

Cumulative weight retained, (Wc):

$$W_c = \text{Current Weight} + \text{Past Weight}$$

$$W_c = 599.6 + 0$$

$$W_c = 599.6 \text{ g}$$

Cumulative percent retained, (%c):

$$\%c = 100 \times \frac{\text{Cumulative Weight in Each Sieve}}{\Sigma \text{ Weight in Each Sieve}}$$

$$\%c = 100 \times \frac{599.6}{5900.5}$$

$$\%c = 10.162 \%$$

Percent passing, (%p):

$$\%p = 100\% - \%r$$

$$\%p = 100\% - 0\%$$

$$\%p = 100 \%$$

$$\%p = \%p_1 - \%r$$

$$\%p = 100\% - 10.162\%$$

$$\%p = 89.838 \%$$

Percent error, (%e):

$$\%e = 100 \times \frac{\text{Original Weight of Sand} - \text{Total Weight Retained}}{\text{Original Weight of Sand}}$$

$$\%e = 100 \times \frac{5910.5 - 5900.5}{5910.5}$$

$$\%e = 0.17 \%$$

Fineness Modulus, (FM):

$$FM = 4 + \frac{\Sigma \text{ Cumulative Percent Retained}}{100}$$

$$FM = 4 + \frac{0 + 26.301 + 87.991 + 99.729 + 99.8}{100}$$

$$FM = 7.138$$

IV. Conclusions

Based on Table 1.2 and 2.2, the percent error of both the sand aggregate and gravel aggregate are 0.12% and 0.17%, respectively. The loss that the two soil samples have undergone during the experiment is less than 1%, which is within the range of acceptable error in an experiment. The computed fineness modulus of the sand aggregate and gravel aggregate are 2.364 and 7.138, respectively. Since the fineness modulus of the sand aggregate is 2.364, it can be assumed that the soil sample is fine sand that has particle size ranging from 0.074 mm to 0.42 mm. While the gravel aggregate fineness modulus resulted in a value of 7.138, it can be assumed that its soil sample is coarse gravel that has the maximum size particle of 40 mm.

V. Things Learned from the Experiment

In this experiment, classifying an aggregate based on its size was learned by performing sieve analysis using ASTM C136-83 method. It has been known that the fineness modulus of fine aggregates are relatively small compared to the fine modulus observed from the coarse aggregates. The results found would be useful in determining if the aggregates are well graded. This experiment also teaches the proper way to treat coarse and fine aggregates. Failure to sweep up the fine aggregates would cause so much of the aggregates to be lost that the test would be insufficiently accurate.

VI. References

Camp, C. (n.d.). *Part 6. Concrete Aggregates*. Retrieved from http://www.ce.memphis.edu/1101/notes/concrete/everything_about_concrete/06_aggregate.html